

SECTION 33 08 17
JACKED AND BORED PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

The Work covered by this Section includes furnishing all labor, materials and equipment required to jack and bore pipe and/or casings to properly complete construction as described herein as directed by the Engineer and/or as shown on the Contract Documents. All work shall comply with the Standard Construction Specifications of the Metropolitan St. Louis Sewer District.

1.2 RELATED WORK

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- C. Dewatering: Section 31 23 19, DEWATERING.
- D. Temporary Construction Fence: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Section 33 30 00, SANITARY SEWERAGE UTILITIES
- F. Section 33 08 19, MICROTUNNELING

1.3 CONTRACTOR'S QUALIFICATIONS

Qualified Contractors will have actively engaged in the installation of pipe using trenchless methods for a minimum of 5 years, during which time the Contractor shall have completed at least 25,000 linear feet of installations.

1.4 SUBMITTALS

In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES, furnish the following:

1. Qualifications: Submit documentation showing that the Contractor and personnel meet the minimum required qualifications stated in this specification. Information must include date and duration of work, location, pipe information (length, diameter, depth, pipe material, etc.) project owner and pipe contents.
2. Tunneling/Jack and Bore Methodology:
A brief description of proposed tunneling methodology for review. The description should be sufficient to convey the following:
 - a. Proposed method of tunnel construction and type of face support.
 - b. Manufacturer and type of tunneling equipment proposed. Describe lighting and ventilation systems (if required).
 - c. Number and duration of shifts planned to be worked each day.

- d. Sequence of operations.
- e. Locations of access shafts/jacking pits and work site arrangement. Describe method of construction of tunnel shafts.
- f. Method of spoils transportation from the face, surface storage and disposal location.
- g. Capacity of jacking equipment and type of cushioning.
- h. Identify critical utility crossings and special precautions proposed.
- i. Slurry injection system details.

3. Tunnel Shafts:

Submit shaft construction drawings together with calculations. As a minimum the submittal shall include:

- a. Shaft dimensions, design criteria, and details for ground support system, such as sheeting, shoring, bracing, and stabilization, protection of the excavations, special requirements for shaft penetrations, tunnel "eye", starter and back tunnels, and seal slabs. Allowable surcharge loads and any restrictions on surcharge capacity, including live loads, shall be clearly shown on the shaft construction drawings. Thrust blocks or other reactions required for pipe jacking shall be shown, if applicable.
- b. Location of shafts by station and limits of working sites.
- c. Description of site security arrangements in conformance with Section 01 00 00 GENERAL CONDITIONS, Operations and Storage Areas.
- d. Description of method of protecting shaft from surface runoff.
- e. Any geotechnical/boring work undertaken by the Contractor for purposes connected to the work.
- f. Design submittals by the Contractor shall be signed and sealed by a Professional Engineer registered in the State of Missouri.

4. Drawings and Calculations:

Submit for record purposes, all drawings and calculations for any tunnel support system designed by the Contractor. Drawings shall be adequate for construction and include installation details. Show pipe and pipe joint details. Documents must be signed and sealed by a Professional Engineer registered in the State of Missouri. Calculations shall include clear statement of criteria used for the design. Review by Owner's Engineer of all drawings and calculations is for information purposes and overall conformance only and does not relieve the Contractor of any liability for the safety and performance of their design.

5. Quality Control:

- a. Method and frequency of survey control.

- b. Example of tunnel daily log.
- 6. Geotechnical Investigation:
When geotechnical investigations are conducted by the Contractor, results of such investigation shall be submitted to the Engineer for record purposes.
- 7. Structure Assessments:
Pre-construction and post-construction assessment reports shall be provided for critical structures, namely those located within 20 feet on either side of all tunnel alignments and all structures within 50 feet of active excavation areas. Photographs or video of any existing/pre-construction damage to those structures in the vicinity of the tunnel alignment shall be included in the assessment reports.
- 8. Traffic Control Plan:
Access to the cemetery must be maintained at all times during operating hours. After hours road closures must be coordinated with the Cemetery Director and Project Manager. If changes to normal traffic flow are proposed, Contractor shall submit a traffic control plan. The plan shall include an outline of the permit acquisition procedure for lane closure (for work on Sheridan Road) and methods for proper signing and barricades, which complies with local requirements and the MUTCD. All traffic control to be installed on Sheridan Road must be also submitted to and approved by St. Louis County Highway and Traffic Department.
- 9. Casing pipe materials, size, and corrosion protection.
- 10. Carrier pipe materials, size, etc..
- 11. Documentation that pipe and/or casing pipe material including the standard to which it is manufactured, outside diameter, wall thickness, joint configuration, and certificate of compliance certifying that the pipe and/or casing pipe meets these specifications.
- 12. Details of casing spacers, including manufacturer's recommended spacing.
- 13. Details of end seals for casing.
- 14. Dewatering Plan.

1.5 DESIGN CRITERIA

- 1. Pipe:
 - a. Contractor is responsible for selection of the appropriate pipe and pipe joints to carry the thrust of any jacking forces or other construction loads in combination with overburden, earth and hydrostatic loads. Design of any pipe indicated on the Contract Documents considers in-place loads only and does not take into

account any construction loads. The criteria for longitudinal loading (jacking forces) on the pipe and joints shall be determined by the Contractor, based on the selected method of construction.

- b. The jacked pipe shall be designed to withstand the thrust from the jacking equipment and pipe advance without damage or distortion. The propulsion jacks shall be configured so that the thrust is uniformly distributed and will not damage or distort the pipe.
 - c. Take into account loads from handling and storage.
 - d. The criteria to be used for truck loading shall be HS-20 vehicle loading distributions in accordance with AASHTO.
 - e. Provide pipes of diameter shown on the Contract Documents. Substitution of pipe with larger diameter to suit jacking equipment available will only be permitted if the Contractor can demonstrate to the Engineer's satisfaction that design flows and velocities can be achieved.
2. Tunnel Shafts:
- a. Shaft design must include allowance for contractor's equipment and stored material and spoil stockpile as appropriate. Design must also allow for HS-20 highway loading if located in the vicinity of a paved area.
 - b. The shaft shall be designed to withstand full hydrostatic head without failure.
 - c. Shaft cover, shall not be used in lieu of shaft perimeter security fencing.
 - d. Steel plate deck, if such is required, shall be designed for HS-20 loading.

PART 2 - PRODUCTS

Contractor shall comply with all manufacturers' recommendations for the approved products.

2.1 SEWER PIPE

Acceptable materials used for sanitary sewers within a casing are as follows:

- a. Polyvinyl Chloride (PVC) and joints to be in accordance with Section 33 30 00, SANITARY SEWERAGE UTILITIES for gravity sewer applications.

2.2 CASING

- A. Unless otherwise required by the agency having jurisdiction, the casing shall be welded steel pipe meeting ASTM A53, Grade B, and have a minimum yield strength of 245 Mpa.

Table of Minimum Wall Thickness for Steel Casing Pipe		
Carrier Pipe Nominal Diameter	Min. Casing Pipe Diameter (O.D.)	Nominal Thickness
6	12	0.344 inch
8	16	0.375 inch
10	22	0.407 inch
12	24	0.469 inch
14	27	0.505 inch
16	30	0.505 inch
18	30	0.505 inch
20	36	0.595 inch
24	36	0.595 inch
30	42	0.625 inch
36	48	0.688 inch
42	60	0.844 inch

- B. The wall thickness shown above shall be increased to the nearest standard size.
- C. Where carrier pipe nominal diameter is greater than 42 inches, then minimum casing pipe diameter (O.D.) shall be great enough to provide a minimum 6 inch clearance between the casing pipe and the "bell" O.D. of the carrier pipe. Thickness design shall be calculated by a professional engineer licensed in the state of Missouri and submitted to the Owner for approval.

2.3 CARRIER PIPE (WITHIN CASING)

The carrier pipe shall be the same material as the sanitary sewer pipeline, unless otherwise directed by Engineer. All pressure carrier pipes shall be restrained jointed in the casing.

2.4 GROUT HOLES

For casing pipes larger than 36 inches in diameter, furnish casing pipe with 2-inch diameter threaded grout holes at centerline and crown for pressure grouting. Spacing of grout holes shall not exceed 5 feet.

2.5 GROUT FOR FILLING VOIDS OUTSIDE OF CASING LARGER THAN 36" IN DIAMETER:

Neat cement grout with a minimum compressive strength of 500 psi and with 5% bentonite.

2.6 WELDING OF CASING PIPE

- A. Welding requirements shall be in accordance with ANSI/AWWA C206. Welding procedures shall be required for, at a minimum, longitudinal and girth or special welds for pipe cylinders, casing joint welds, reinforcing plates, and grout coupling connections.
- B. Welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the type of materials to be used. Welders shall be qualified under the provisions of ANSI/AWS

D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing work on the casing or pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests. The Contractor shall be responsible for all material and bear the expense of qualifying welders.

2.7 CASING SPACERS

Casing spacers shall be sized sufficiently to provide a minimum clearance of two (2) inches between outside of carrier pipe bells or couplings and inside of casing. The spacers shall consist of the following components:

1. Spacer Band Material: Minimum 14-gauge steel band of either Type T-304 stainless steel or Carbon steel coated with fusion bonded epoxy or PVC coating.
2. Spacer Liner Material: Ribbed liner of PVC or EPDM rubber designed to overlap the edges of the spacer band and prevent slippage. Liner shall have a minimum thickness of 0.090 inches and a hardness of 85-90 durometer "A".
3. Spacer Width: As recommended by spacer manufacturer for the specific application. Minimum width shall be 8 inches. Manufacturer's approval in writing shall be required for installations exceeding 300 feet in length, carrier pipes in excess of 48 inches in diameter or multiple carrier pipes in casing.
4. Spacer Risers and Runners must be:
 - a. Risers must be minimum 10-gauge steel risers of same material and requirements as spacer band. Risers shall be MIG welded to spacer band prior to coating. Risers must be suitable for supporting the weight of carrier pipe.
 - b. Runners shall be manufactured of an abrasion resistant material having a low coefficient of friction (0.1 to 0.6) and designed to support the carrier pipe without damage or excessive wear. Runner material shall be of glass reinforced polyester or nylon and have a minimum compressive strength of 18,000 psi (ASTM D 695).
5. All hardware and fasteners shall be stainless steel.
6. Hardwood skids shall NOT be used in place of manufactured casing spacers.

2.8 CASING END SEALS:

End seals shall be made of synthetic rubber, conical shape, pull-on or wrap-around style with Type 304 stainless steel bands. For carrier pipe greater than 24 inches in nominal diameter the annular space between the carrier pipe and the casing pipe at the ends shall be bricked in conjunction with the end seals.

PART 3 - EXECUTION

3.1 EQUIPMENT

Contractor shall utilize equipment and methods designed to install pipe and/or casing as shown in the Contract Documents. Operation of equipment shall be performed by qualified personnel, experienced in this type of work. Selected equipment shall be capable of accurate alignment and grade control, and shall protect against subsidence or other disturbance of ground, existing utilities, existing road surface, and existing structures.

3.2 PREPARATION

Confirm location of all known existing utilities prior to start of jacking/receiving pit excavation and pipe installation. The Contractor shall provide the detailed layout required to keep the bore on grade. Notify the Engineer no less than 7 working days before beginning shaft excavation. Before beginning construction of jacking/receiving pit, adequately protect existing structures, utilities, trees, shrubs, and other existing facilities. Place fencing, gates, lights, and signs, as necessary around shafts and staging areas to provide for public safety. When preparing to install casing pipe, verify casing pipe minimum wall thickness is adequate for anticipated jacking loads.

3.3 LOCATION OF TUNNEL SHAFTS/JACKING PITS:

- A. The number of tunnel shafts shall be kept to a minimum and shall be typically sited at proposed manhole locations.
- B. When shaft sites are indicated on the Contract Documents, the Contractor may alter locations of shaft sites as needed for construction operations. Relocation shall be subject to the Engineer's approval.
- C. Locate shafts and associated work areas to avoid blocking traffic, and to minimize disruption to Cemetery operations and visitors.
- D. Locate shafts and associated work areas to avoid any major utility relocations. Any required utility relocations for shaft construction shall be coordinated by Contractor with the utility owner and are incidental to the work. Contractor shall include all costs associated

with utility line conflicts (additional support, relocations, and coordination with utility) in their base bid.

- E. The Contractor shall verify all existing utilities, pipelines, and structures in the project area, and take all precautions and measures to protect them during the installation, subsequent tunneling and backfilling of the shafts after completion of sanitary sewer installations. Relocation of any and all utilities for the construction of temporary shafts are considered incidental to shaft construction and shall be included in the Contractor's base bid.
- F. Plan shaft locations to minimize interference with storm drainage channels, ditches, water mains, sanitary sewers, storm water sewers or culverts, which, if damaged, could result in ground washout or flooding of shafts and tunnels.

3.4 CONTROL OF GROUNDWATER

Provide groundwater control measures in conformance with Section 31 20 00, EARTH MOVING, when necessary to the work. Contractor shall maintain tunnel shafts in a dry condition so as to not cause project delays or additional stresses within the shaft.

3.5 JACKING/RECEIVING PIT

Methods of construction for jacking/receiving pits shall be such as to ensure the safety of the Work, Contractor's employees, the public, existing utilities, and adjacent property and improvements, whether public or private. Provide complete groundwater control for excavations at all times. Perform jacking/receiving pit excavations using appropriate excavation or large hole drilling methods, as required. Inspect shaft/pit excavations daily to check safety of excavation and structural integrity of support system. Open excavations shall conform to all federal, state, and local requirements.

3.6 LUBRICATION OF EXTERIOR OF PIPE AND/OR CASING

Bentonite slurry may be used to lubricate exterior of pipe and/or casing during installation. Use of water to facilitate removal of spoil is permitted; however, water jetting is not allowed.

3.7 BORING

The boring shall be accomplished by means of auguring to the size, line and grade shown on the Contract Documents or as directed by Engineer. The diameter of the bore shall be minimal to complete the jack and boring operations. Re-drill pilot hole when bore does not meet specifications.

3.8 PIPE-JACKED TUNNELING DATA

A. Maintain shift logs of construction events and observations. The Engineer shall have access to the Contractor's logs with regard to the following information:

1. Location of boring machine face or shield by station and progress of tunnel drive during shift.
2. Hours worked per shift on tunneling operations.
3. Completed field forms for checking line and grade of the tunneling operation, showing achieved tolerance relative to design alignment. Steering control logs will generally be acceptable.
4. Maximum pipe jacking pressures per drive.
5. Location, elevation and brief soil descriptions of soil strata.
6. Ground water control operations and piezometric levels.
7. Observation of any lost ground or other ground movement.
8. Any unusual conditions or events.
9. Reasons for operational shutdown in the event a drive is halted.

3.9 JACKED AND BORED PIPE AND/OR CASING

Bore hole diameter shall not exceed outside diameter of casing by more than one (1) inch. When unstable soil conditions are found to exist, conduct boring operations in a manner that will not be detrimental to facility being crossed. Casing horizontal line tolerance is one (1) inch, maximum. Casing vertical line tolerance is two (1) inch maximum. A means of steering the pipe or casing must be provided to ensure allowable tolerance can be achieved. The Contractor must measure and record progress at all times to confirm that these tolerances are achieved. For casing: Weld sections of casing pipe together to provide watertight joints by operators qualified in accordance with the American Welding Society Standard Procedures. These welds shall be continuous, complete joint penetration butt joint welds as required for rigid and watertight connections. If the removal of casing pipe is permitted, make proper provisions to prevent caving in of the earth surrounding the casing. If it is necessary to abandon a bored hole, remedial measures shall be taken by the Contractor, subject to review by the Engineer of facility being crossed. If required grade tolerance has not been achieved, correct grade using casing spacers of varying height per manufacturer's recommendations.

3.10 MONITORING OF SURFACE MOVEMENT

Perform a preconstruction survey of road surface. Contractor shall record horizontal coordinates and elevations. Mark location of where measurements were taken. Monitor movement of road surface on a daily basis and provide results to the Engineer. Stop operations if movement exceeds $\frac{1}{4}$ inch and immediately notify the Engineer.

3.11 GROUTING JACKED AND BORED CASINGS

Applies to casing pipes larger than 36 inches in diameter. Once casing is in position, pressure grout through grout holes provided to fill voids outside of casing. Start grouting at centerline hole at one end and pump grout until grout appears in grout hole at the crown, then start grouting through opposite spring line hole until grout appears at hole in crown. Grout through hole at crown until grout appears in next set of holes along casing. Plug holes at starting point and move to next set of holes and repeat grouting sequence until full length of casing has been grouted.

3.12 INSTALLATION OF CARRIER PIPE WITHIN CASING:

Entire length of casing shall be installed complete and inspected and approved by Engineer before any carrier pipe is placed therein. Repair defects in casing pipe or leakage at joints. Install a minimum of three casing spacers to each length of carrier pipe in such a manner that electrical continuity will not occur between casing pipe and carrier pipe. Spacers shall be placed on each side of each joint and at 8-foot maximum spacing between joints. Check each joint makeup and pipe segment prior to pushing carrier pipe segments into casing. When the carrier pipe is a PVC pressure pipe install megalug or other suitable mechanical joint restrainers to one joint beyond casing, unless otherwise directed by the Engineer. Casing end seals shall be provided at the end of the casing pipe after installation of the carrier pipe.

3.13 CASING PIPE AND CARRIER PIPE ANNULAR SPACE:

The annular space shall be completely filled with Class "B" concrete.

3.14 REMOVAL OF JACKING/RECEIVING PIT SUPPORT SYSTEM:

Remove support elements, except those required by Engineer to remain in place, from excavation. In addition, remove support elements as needed to install the pipeline. Removal of support system shall be performed in a manner that will not disturb or harm adjacent construction or facilities. Fill voids created by removal of support system with clean sand, flowable fill, or a similar fill material approved by Engineer.

3.15 BACKFILLING OF JACKING/RECEIVING PIT:

Seal jacking/receiving pit opening and backfill at shafts when no longer required.

3.16 DISPOSAL OF EXCESS MATERIAL

Remove spoils in accordance with Section 31 20 00, EARTH MOVING and Section 02 45 00, DEMOLITION AND SITE CLEARING.

3.12 ACCEPTANCE TESTING

Acceptance testing and inspection is to be carried out by methods described in Section 33 30 00, SANITARY SEWERAGE UTILITIES.

3.17 SITE RESTORATION

All surfaces affected by the Work shall be restored to their preconstruction conditions. Performance criteria for restoration work will be similar to those employed in traditional open excavation work as described in Section 31 20 00, EARTH MOVING.

3.18 POST CONSTRUCTION EVALUATION

- A. The Contractor shall provide a set of Field Record Drawings including both alignment and profile to the Engineer. Drawings should be developed from actual field readings. Raw data should be available for submission at any time upon request. As part of the Field Record Drawing, the Contractor shall specify the tracking equipment used, including method of confirmatory procedure used to ensure the data was captured. Field Record Drawings having survey data shall be stamped by a Professional Land Surveyor registered in the State of Missouri.
- B. All fittings, valves, manholes, connections, etc., including all critical structure monitoring points as shown on Contract Documents, shall be located by GPS and based on the Missouri State Plane - East coordinate system as shown on Contract Documents and shall be provided on the Field Record Drawings. No landmarks shall be used. The record drawings shall be stamped by a Professional Land Surveyor registered in the State of Missouri.
- C. Record station of casing ends.

3.19 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the site.

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